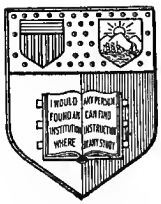

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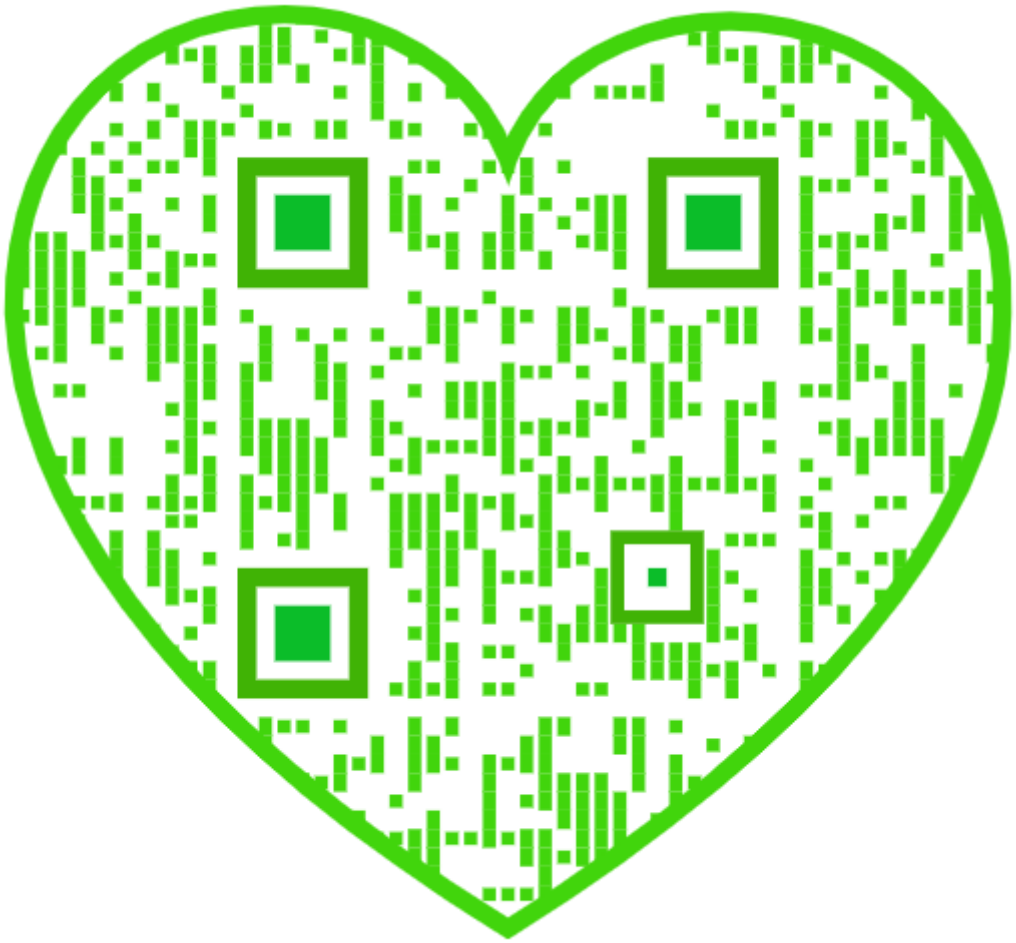

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Agricultural College Extension

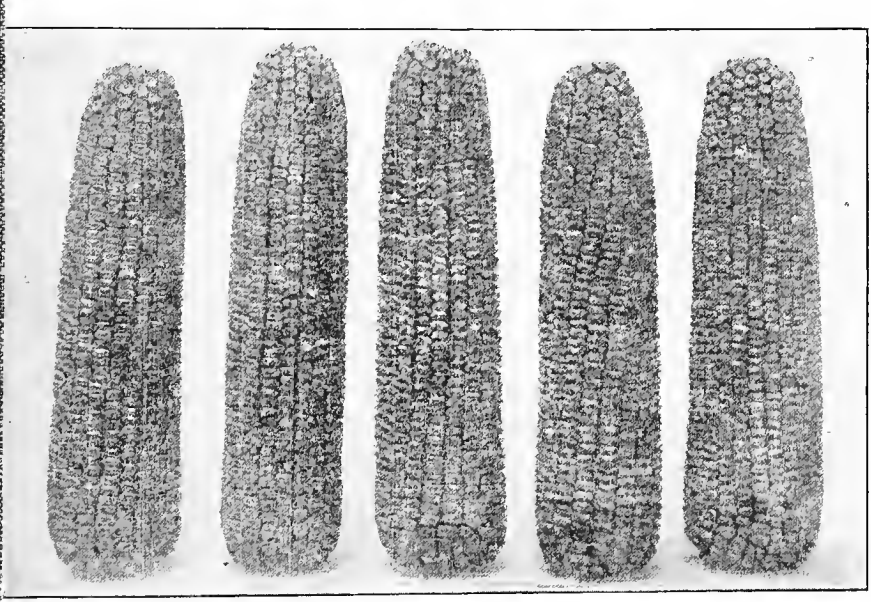
UNIVERSITY OF ILLINOIS

STUDIES OF CORN AND ITS USES

FOURTH EDITION

Suggestions for Young People's Experimental Clubs and Instruction in Agriculture in Public Schools

Prepared by Fred H. Rankin,
Superintendent Agricultural Extension,
Urbana, Illinois.



Five Good Ears Leaming Corn

"Aye, the corn, the royal corn, within whose yellow heart there is of health and strength for all the nations."—*Richard J. Oglesby.*

SEPTEMBER, 1912

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"The best product of the prairie is not corn, but men, and the quarter section that produces a thinking man, full fledged in all his powers, may well be held to have performed its mission."—Gov. L. M. Shaw.

SUGGESTIONS FOR YOUNG PEOPLE WHO DESIRE A MORE SYSTEMATIC STUDY OF CORN

This circular is designed to be helpful to boys and girls who wish to become familiar with the characteristics of corn; to arouse their interest and quicken thought, and to aid them in studying practical facts and principles in agriculture to the end that they may be led on to an intelligent preparation for the successful practice of some branch of farming.

We are all interested in plant life even more than we realize. None of us would willingly live in a place where there were no green grass, beautiful flowers or graceful, symmetrical trees. Who can estimate the elevating and refining influence of flowers and plants with their graceful forms, beautiful shades and combinations of colors and exquisitely varied perfumes? These silent influences are unconsciously felt even by those who do not appreciate them consciously. The same is true of fruits, grasses and grains. Are you not impressed by the beauty and fragrance of an apple orchard in full bloom, the black locust or catalpa trees, as well as the field of clover, alfalfa or winter vetch? These things appeal to us from the standpoint of beauty and sentiment as well as from the dollars and cents point of view.

While every one has a general interest in plants because they are living and growing things, many of the boys and girls of Illinois are taking a special interest in some particular plants as Corn, Sugar Beets and Potatoes, since special premiums are offered at many of the County Farmers' Institutes for these.

Plan for Corn Judging Contest

Several counties are planning to introduce a corn judging contest into their institutes this year. The following is the plan of procedure recommended by the Illinois Farmers' Institute:

1. A premium is to be offered for skill in judging corn.
2. The premium to be a trip to the State University the last two weeks in January and instruction in corn judging and such other subjects as may be provided by the Dean of the College of Agriculture.

3. Conditions: (*a*) No one to be allowed to take part in this contest who is less than 15 years of age or more than 21 years. (*b*) No one allowed to take part in the contest who has ever attended a corn class in an agricultural college.

4. Requirements: (*a*) Each contestant must bring to the Institute the best 10 ears of corn he can select from corn grown on the home farm. (*b*) Each contestant must attend the day sessions of the Institute.

5. An expert corn judge to be provided who will give instructions to all competitors on the first day of the Institute and examine them on the second day.

"Know How" and "Reason Why" is the Team that Draws the Car of Success

To be successful in these contests it is necessary to be very observing and learn more as to *why* and *how* plants grow; and why some plants, like some men, thrive and prosper better than others. The best and surest way to do this is to grow the plants and watch them carefully through their interesting progress of growth to fruitage. It is important not only to study *about* the thing, but to *study the thing itself.*

The winners in these contests will be those who this year systematically study corn and plants. Expert corn judges are not made in a day or week. It is the boy who intelligently and patiently studies the growing corn plant and spends his spare moments studying the ears and kernels of corn of different varieties who will win these premiums and be awarded the honor of having his expenses paid to attend the Two Weeks' Course in Agriculture at the University of Illinois, where the opportunity will be afforded of earning a certificate as an expert corn judge.

Two Weeks' Course in Agriculture

At the time of the Corn Growers' and Stockmen's Convention, beginning January 13, 1913, and continuing two weeks, the College of Agriculture will give instruction in certain subjects of especially practical importance to young men on the farm, such as judging of corn, testing of seed, operating the Babcock test to determine the amount of butter fat in milk, practice in stock judging, knotting and splicing of ropes, adjustment of farm machinery, lectures on veterinary science, etc.

This work will be arranged and conducted with special reference to the young men who compete at the various Farmers' Institutes for prizes involving a trip to the State University and

attendance upon this course. Is it not worth while to study corn as you never did before and put yourself in line for winning this premium and thus receive free of all expenses the great and lasting benefits from such a Course and Convention? It is an opportunity knocking at your door. Will it be improved?

To assist in a study of the varieties of corn and its uses in a systematic manner we will divide the circular as follows:

Part 1—Studies of the Corn Plant.
Part 2—Studies of an Ear of Corn.
Part 3—The Corn Score Card.
Part 4—Studies of the Different Parts of a Kernel of Corn.
Part 5—The Commercial Products of Corn.
Part 6—Suggestions for Corn Experiments.

Acknowledgment is made to Professor Thomas F. Hunt, author of "Cereals in America," Dr. C. G. Hopkins, of the Illinois Agricultural Experiment Station, and Mr. A. D. Shamel for suggestions and matter used in the preparation of this circular.

The Making of Educated Farmers

One of the aims of College Extension is to popularize agricultural education and be practically helpful to young people in an educational way that they may have grasp and power to work the problems which confront them in life. If any young person who reads these lines desires the aid and suggestions of a sympathetic friend who would suggest rather than command, guide rather than lead, and direct to information relative to the Agricultural College, he is cordially invited to make inquiries of the undersigned.

Fred H. Rankin,
Superintendent Agricultural Extension,
Urbana, Illinois.

PART I.

Studies of the Corn Plant

The development of the present breeds of cattle and other live stock plainly shows how careful, systematic and intelligent selection has improved the animals. Plants respond to breeding and selection as readily as do animals and there is no longer any doubt that varieties of corn may be further improved by similar methods. Experiments conducted by the Illinois Agricultural Experiment Station and other similar institutions have conclusively shown that the composition of the corn kernel may be varied at the will of the careful breeder; that it is possible to increase or decrease the amount of oil, or of starch, or of protein by selection of seed. An explanation of the different parts of the kernel of corn is given beginning on page 20.

It is equally true that greater variations may be made in the ears or the stalks by selection. The amount of husks, length of shank, size and height of stalk, position of ear on the stalk, the number of leaves, and in fact every physical characteristic can be varied in a short time by simple selection. It is just as important to know the character of every part of the corn plant as to know every characteristic of the animal. The size, shape and characteristic of the stalk strongly influence the development of the ear and kernel of corn.

Studies of the Corn Plant

Name of variety———— Size of field————

1. Date the corn matures: (*a*) roasting ear ————
   (*b*) dented or glazed———— (*c*) ripe————
2. Height of corn; average of ten plants———— feet———— inches ————.
3. Total number of leaves on ten plants, taken from different hills———
   Average number of leaves per plant————
4. Total number of leaves below the ear on ten plants taken from different hills———— Average————
5. Figure the total leaf surface on five average corn plants (for each leaf blade take twice the product of the length and average width) ————
6. Length of ear stem, or shank (distance from joint, or node, to base of ear) average of ten plants————

7. The ear stem, or shank, may be (1) *large*,—nearly or quite the diameter of the cob; (2) *medium*,—or about half the diameter of the cob; (3) *small*—or one-third or less the diameter of the cob.
8. Husks: abundant, medium, scarce———————
9. Husks: close, medium, loose———————
10. Measure ten hills square; give number of ears on these one hundred hills———————Average per hill———————
11. Give number of stalks in the above area having two or more ears——
12. Give number of stalks in above area without ears (barren stalks)——
13. Give average height of ears in above area———————
14. Position of the ears on stalks; pointing upward; horizontal; pointing downward———————
15. Distance apart of hills each way———————
16. Give number of hills per acre———————
17. Measure off one acre which represents a good average of the field; husk one-twentieth of this and after weighing same carefully estimate the average yield of field———————
18. If hills of corn are 3 ft. 6 in. each way, how many hills to the acre?

———————

19. If, in a field of corn planted 3 ft. 6 in. each way, there is on the average 1½ pounds of corn to each hill, counting 80 pounds to the bushel to allow for shrinkage, what is the yield per acre?———————
20. If corn is planted 3 ft. 6 in. each way, and when mature is cut and put into shocks each shock containing the corn from an area 14 hills square, how many shocks to the acre?———————

How many if the shocks are 16 hills square?———————

The following table will assist in making accurate estimate of the amount of land in different fields or plots:

10	rods	x 16	rods	= 1	acre.	220	feet x 198	feet	= 1 acre.
8	"	x 20	"	= 1	"	440	" x 99	"	= 1 "
5	"	x 32	"	= 1	"	110	" x 396	"	= 1 "
4	"	x 40	"	= 1	"	60	" x 726	"	= 1 "
5	yards	x 998	yards	= 1	"	120	" x 363	"	= 1 "
10	"	x 484	"	= 1	"	240	" x 181.5	"	= 1 "
20	"	x 242	"	= 1	"	200	" x 108.9	"	= ½ "
40	"	x 121	"	= 1	"	100	" x 145.2	"	= ⅛ "
80	"	x 60½	"	= 1	"	100	" x 108.9	"	= ¼ "

AREA OF ONE ACRE

10 square chains = 1 acre.
160 " rods = 1 "
4,840 " yards = 1 "
43,560 " feet = 1 "
640 acres = 1 square mile.
36 square miles (6 miles sq.) = 1 township.

PART II.

Studies of an Ear of Corn

In order to become accustomed to the essential points in studying the characteristics of corn the following suggestions are appended. Take ten ears each of two or more different varieties, preferably one yellow, one white, selecting ears as uniform and true to the variety type as possible. To get a close comparative study it is advisable to lay all the samples on a table side by side. After studying the characteristics carefully, use this list for reference and bring out by example the points mentioned: then the work of scoring the samples may be taken up, following carefully the several points indicated on the corn score card as given on page 11 of this circular and noting carefully the explanatory notes. Each sample of ten ears should be marked and known as "Exhibit A," "Exhibit B," etc. The letters "*a*" and "*b*" as used below refer to the sample under examination, and it is intended that the corresponding characteristics possessed by each variety be marked in the blank space.

Name of variety *(a)*_____ *(b)*_____

I. Color of grain: white; yellow; golden. *(a)*_____ *(b)*_____

II. Color of cob: white; light red; dark red. *(a)*_____ *(b)*_____

III. Surface of ear: smooth; rough; very rough. *(a)*_____ *(b)*_____

IV. Rows of kernels:

1. Are rows in distinct pairs (alternate spaces between rows of kernels wider than the others)? *(a)*_____ *(b)*_____

2. Number of rows (count three inches from butt). *(a)*_____ *(b)*_____

3. Number of rows lost (disappearing after extending three inches or more from butt). *(a)*_____ *(b)*_____

4. Spaces between rows: medium; narrow; wide. *(a)*_____ *(b)*_____

5. Are rows straight (parallel with cob)? *(a)*_____ *(b)*_____

6. Are rows turned to the right or left (twisted to right or left of a straight line from butt to tip)? *(a)*_____ *(b)*_____

V. Grains on cob: dovetailed or mosaic like; firm; loose; very loose. *(a)*_____ *(b)*_____

VI. Shape of ears:

1. Cylindrical (uniform in circumference from butt to tip). *(a)*_____ *(b)*_____

2. Partly cylindrical (uniform in circumference for a portion of length). *(a)*_____ *(b)*_____

3. Slightly tapering (taper slight and regular). *(a)*_____ *(b)*_____

4. Distinctly tapering (taper very apparent). *(a)*_____ *(b)*_____

5. Very tapering (extremely tapering). *(a)*_____ *(b)*_____

6. Are the ears in the exhibit too short or too long for their circumference? (The proper proportion is for Northern Illinois, 6.50 inches minimum circumference to 8.50 inches minimum length; for Central and Southern Illinois, 6.50 inches minimum circumference to 9.50 inches minimum length.) *(a)*_____ *(b)*_____

VII. Butts of ears:

1. Even (entire end of cob exposed, with butt kernels at right angles to axis of cob). *(a)*_____ *(b)*_____

2. Shallow rounded (cavity at butt shallow, broad). *(a)*_____ *(b)*_____

3. Moderately rounded (cavity moderately deep, medium diameter). *(a)*_____ *(b)*_____

4. Well rounded (cavity at butt deep, small diameter where the shank is removed, rows of grains extending in regular order over the butt). *(a)*_____ *(b)*_____

5. Compressed (cob rounded at end; kernels at butt flat, smooth and short, indicating a tight husk). *(a)*_____ *(b)*_____

6. Enlarged (large butt with no extra rows of kernels). *(a)*_____ *(b)*_____

7. Expanded (large butt caused by extra rows of kernels). *(a)*____ *(b)*_____

VIII. Tips of ears:

1. Kernels in rows (rows may be traced to tip). *(a)*_____ *(b)*_____

2. Flat (cob flattened at tip). *(a)*_____ *(b)*_____

3. Filled (entire end of cob covered with kernels). *(a)*_____ *(b)*_____

4. Capped (a central kernel projecting from filled tip). *(a)*____ *(b)*_____

IX. Kernels:

1. Firm (rigid on cob). *(a)*_____ *(b)*_____

2. Loose (moveable on cob). *(a)*_____ *(b)*_____

3. Upright (at right angles with surface of cob). *(a)*_____ *(b)*_____

4. Sloping (leaning toward tip). *(a)*_____ *(b)*_____

5. Square at top (corners not rounded at summit). *(a)*_____ *(b)*_____

6. Shoe-peg form (long narrow kernel holding size to tip. *(a)* _____ *(b)*_____

7. Rounded corners (corners rounded at summit and base). *(a)* _____ *(b)* _____

8. Beaked (with long, sharp, tapering projection). *(a)* _____ *(b)* _____

X. Junction of ear stem, or shank, with ear: large; medium; small. *(a)* _____ *(b)* _____

XI. Average length of ears: *(a)* _____ *(b)* _____

XII. Average circumference of ears one-third distance from butt: *(a)* _____ *(b)* _____

XIII. Give ratio of circumference of average ear to length of average ear (divide length of ear by circumference of ear). [The proper proportion of circumference to length is as 3 to 4; or for medium varieties 7.5 to 10 inches.] *(a)* _____ *(b)* _____

XIV. Weigh five ears from each sample, taking each alternate ear; give average weight of ears. *(a)* _____ *(b)* _____

XV. Shell these five ears and give average weight of cobs. *(a)* _____ *(b)* _____

XVI. Give average circumference of cobs one-third distance from butt. *(a)* _____ *(b)* _____

XVII. Give ratio of circumference of average cob to average ear (divide circumference of ear by circumference of cob). *(a)* _____ *(b)* _____

XVIII. Give percentage of grain: [Note: To determine the percentage or proportion of grain to cob, select every alternate ear in the exhibit and weigh same. Shell, and weigh the cobs; subtract the weight of the cobs from the total weight of the ears, giving weight of shelled corn. Divide the weight of shelled corn by the total weight of ears, which will give the percent of grain. The percent of grain should be from 86 to 90.] *(a)* _____ *(b)* _____

XIX. Count the number of kernels of corn on the largest ear and on the smallest ear in each exhibit. *(a)* _____ *(b)* _____

XX. To illustrate 1 under section VI select 10 ears as cylindrical in shape as can be found weigh each ear carefully, record the weights and then shell and weigh each cob, carefully recording the weights. From these weights figure the proportion of corn to the ear, and find the average. Do this same work with ten tapering ears and compare the results.

XXI. Try this same proof with ears having straight and crooked rows of kernels, and with ears having deep wedge-shaped and rounded kernels. Compare your results. Is there a reason for desiring the cylindrical ears with straight rows of wedge-shaped kernels?

PART III.

The Corn Score Card

The object of corn judging is to determine the corn of the highest quality either for feeding or market and which is consequently the most profitable to grow.

The study of these desirable characteristics is a comparative rather than an individual study and has led to the formulation of these general points in a so-called score card or standard scale of points. As the result of careful study this standard of perfection has been improved and carefully revised by the Illinois Corn Growers' Association, giving the different points of an ear of corn and their proper degree of importance.

The use of the score card or standard of perfection, has been adopted as the best method of comparing samples of corn and is invaluable as a guide to the judge or student of corn judging, in keeping in mind a proper estimate of the proportional importance and relative merits of a sample of corn.

There is no better way to sort and select seed corn or to prepare a sample for exhibition than to place the ears from a bushel or so of selected corn upon some board or table, with the tips all pointing one way. Select the most perfect ear you can find, something which is your ideal type. Then with this ear in your left hand go over all the ears of corn upon the table, discarding those showing too great a variation from type in size, length, shape, roughness, and the size, shape and indentation of kernel, etc.

Suggestions for Preparing Exhibit

In judging corn ten ears usually constitute an exhibit sample. It is desirable that samples be laid out side by side on a table where a good light may be had.

In preparing corn for exhibition, the ears should be groomed so as to present the best possible appearance by removing all husk, silks and shanks, but do not mutilate or cut the ear itself in any way. Neither is it allowable to remove mixed kernels and substitute kernels of a proper color. The ears should be handled carefully that no kernels be knocked off, for kernels that are missing are usually regarded mixed and the usual cut made for such imperfection. If the exhibit is to be sent away each ear should be carefully wrapped in a piece of newspaper or other protection and firmly packed in a box.

Score Card

The following is the score card of the Illinois Corn Growers' Association as revised and adopted by that Association January 25, 1911.

The form indicated is a convenient arrangement for judging and studying individual samples of corn and provides for (1) judging a sample, marking the score in the column headed "first score;" then cover this score over and do not refer to it; (2) rescore sample, marking the score in the column headed "second score." By comparing these scores a careful study may be made and a corrected and final score put down.

Corn Score Card

Name of Scorer_____ Date_____

Postoffice_____ Exhibit No._____

Standard Measurements of Variety

Name of Variety_____

Length_____

Circumference _____

Proportion of Grain to Cob_____

Points	Perfect score	First score	Second score	Corrected score
1. Uniformity of exhibit	5			
2. Shape of ear	10			
3. Length of ear	10			
4. Circumference of ear	5			
5. Tips of ear	5			
6. Butts of ear	5			
7. Kernel uniformity	5			
8. Kernel shape	5			
9. Color in grain and cob	10			
10. Space between rows	5			
11. Space between kernels at cob	5			
12. Vitality or seed condition	10			
13. Trueness to type	10			
14. Proportion of shelled corn to cob	10			
Total	100			

Measurements for Standard Varieties

There are a number of standard varieties or breeds of corn having variety characteristics which are recognized as distinct

as are the individual characteristics of the Shorthorn, Hereford or Angus breeds of cattle.

Certain varieties of corn have been grown and bred for a long time by men who by improved methods have developed certain characteristics of stalk and ear, such as color and shape of kernel, shape and size of ear, etc. Furthermore, each variety has its peculiar length, circumference and proportion of corn to cob. Based on a careful study of the best samples of the different varieties recognized by the Illinois Corn Growers' Association these variety standards are as follows:

Northern District of State.	Minimum length	Minimum circumference	Per cent of grain to cob
Reid's Yellow Dent	8.5 in.	6.5 in.	88
Leaming	8.5 in.	6.5 in.	88
Boone or Johnson Co. White	8.5 in.	6.5 in.	88
Riley's Favorite	8.5 in.	6.5 in.	90
Golden Eagle	8.5 in.	6.75 in.	90
Silver Mine	8.5 in.	6.5 in.	90
Champion White Pearl	8 in.	6.5 in.	85
Central and Southern District of State.			
Reid's Yellow Dent	9.5 in.	6.75 in.	88
Leaming	9.5 in.	6.75 in.	88
Boone or Johnson Co. White	9.5 in.	6.75 in.	88
Riley's Favorite	9 in.	6.75 in.	90
Golden Eagle	9 in.	7 in.	90
Silver Mine	9 in.	6.75 in.	90
Champion White Pearl	8 in.	6.75 in.	85

Measurements for General Standard

A general standard of perfection is recognized. This should be used in judging varieties or samples not named and also where the exhibit is not made under a variety classification; it is as follows:

	Minimum length in inches	Minimum circumference in inches	Proportion
*Northern Illinois	8.5	6.5	88%
Central and Southern Illinois	9.5	6.75	88%

*The length and circumference of the general score card for the Northern district shall be used in judging the standard varieties when shown within that district of the State.

Explanatory: How to Study and Apply the Points of the Score Card

Note A: The score card can not be used in an absolutely mathematical sense. No set rules can be given; it is largely a matter of the exercise of good sound judgment and patient practice on the part of the scorer. Where the number of points to be cut is not fixed by rules for judging, such as circumference, length, etc., the cut made should be according to the degree of variance of each ear from value of the perfect ear fixed by Standard.

Note B: In all exhibits made prior to November 15 of each year, all standards of length and circumference shall be increased one-half inch, and standards of percent shall be reduced two.

Note C: Exhibitors may remove two kernels side by side from the same row at the middle of the ear for kernel examination.

1. Uniformity of Exhibit.—5 Points: The ears should present a uniform appearance in *shape, length* and *circumference*. The shape of the different ears of the exhibit should be uniformly the same; but the *kind* of shape is not taken into consideration at this time. [This is considered under the second point of the score card, "Shape of Ear."] For example, the shape may be very poor but if all the ears are alike they must be counted of uniform shape. The size may be too large or too small but if all the ears have the same size the exhibit would be considered uniform in this respect. An irregular exhibit lacking in uniformity shows a poor selection.

A simple way to decide upon the marking for uniformity is to rearrange the exhibit pushing out all irregular ears, placing the uniform ears together and then decide upon the cut to be made from the proportion of the uniform to the not uniform ears.

2. Shape of Ears.—10 Points: In general the ear should be *cylindrical* carrying the same circumference from butt to tip with proper proportion of length to circumference, being full and strong in the middle portion, thus allowing the development of uniform, deep kernels from butt to tip (See XX under part II) which is essential to a large percentage of corn to cob. The shape of ear will vary with the variety and it should conform to the variety type. For instance; the shape of the Boone County White ear is quite cylindrical, while that of the Leaming may be slightly tapering. Each variety has its individual breed peculiarities of shape. The straightness of the rows should be par-

ticularly taken into account under this division. The rows should all run parallel to the axis of the cob. (See XXI under part II). If they are irregular or turn to the right or left in a spiral manner, a proper cut should be made.

3. Length of Ears.—10 Points: The length of the ear varies according to the variety measurement. Uniformity of length is to be sought for in an exhibit; and an exhibit having an even length of ears should be scored higher than one that varies even though it be within the limits of standard measurement.

4. Circumference of Ears.—5 Points: The circumference varies according to the variety measurement. Measure for circumference at one-third the distance from the butt to the tip and record measurement. The deficiency or excess of circumference of all ears should be added together and for every inch thus obtained a cut of one point should be made.

5. Tips of Ears.—5 Points: The form of the tips should be regular oval shape; the rows of kernels should extend in straight regular order over the tip and be large and of uniform size and shape. Long, pointed tips, as well as short, flattened or double tips are objectionable. A cut of from one-tenth to one-half point should be made on each tip according to irregularities of shape and exposure of cob. A tip exposed one inch should be cut one-half a point, and for lesser exposure cut in proportion.

6. Butts of Ears.—5 Points: The rows of kernels should extend in regular order over the butt, leaving a deep depression when the shank is removed. Open and swelled butts, depressed and flat butts with shallow glazed kernels are objectionable and should be cut from one-tenth to one-half a point according to the judgment of the scorer.

7. Kernel Uniformity.—5 Points: The size and shape of the kernels in all of the ears should be the same. This feature is quite desirable thereby making it possible to secure uniformity in dropping with the planter, and consequently a good stand. The kernels from the same ear and from the several ears should not only be uniform in shape and size, but uniform in color and indentation and true to variety type. To examine for kernel uniformity take out two kernels from about the middle of each ear and lay them out in front of each ear with the tips of the pairs of kernels pointing towards the ears. In this position the comparative shape, size, etc., can easily be noted. The marking on this point is largely a matter of judgment and cannot be fixed by rule.

8. Kernel Shape.—5 Points: The shape of the kernel will

depend upon and vary somewhat with the variety. However in general, the kernels should be deep and wedge-shaped so that their edges touch from tip to crown. (See XXI under part II.) They should be full and strong at the tips; having large, strong germs. Very large or very small kernels are objectionable.

9. Color of Grain and Cob.—10 Points: The kernels should be free from mixture and true to variety color. In judging color a white cob in yellow corn or a red cob in white corn should be cut 10 points. In many cases the individual kernels are tinted, the yellow with white and the white with yellow color which indicates that this kernel has been fertilized by a stray pollen grain. For each mixed kernel up to five, a cut of one-fifth of a point should be made; for five or more mixed kernels a cut of one point should be made. Kernels missing from the ear may be counted as mixed at the discretion of the judge. Difference in shade of color of grain or cob, should be scored according to variety characteristics.

10. Space Between Rows.—5 Points: Space between rows is the furrow between the rows of kernels formed by the rounding off of the tops of the kernels. Ears having kernels which are shallow and rounded at the corners usually have space between the rows and yield a comparatively small percentage of corn to the cob.

11. Space Between Kernels at Cob.—5 Points: To examine for "space at cob" remove several kernels near the middle of the ear and note if there is space between the tips of the kernels in an undisturbed row where they join the cob. Space between the kernels in the row where they join the cob is very objectionable since it denotes immaturity, a weak constitution and poor feeding value.

12. Vitality or Seed Condition.—10 Points: Ears should be well matured, sound, dry and in good seed condition, the germ should be bright and fresh, showing strong vitality and being capable of producing strong, vigorous growth and yield.

13. Trueness to Type.—10 Points: The 10 ears of the exhibit should conform to and possess the variety characteristics, each ear being true to the variety which it represents, in size, shape and color, and indentation, size and shape of kernel. If the exhibit be judged in the general classes then the prevailing type should be considered the standard. An exhibit uniformly true to type is one of the evidences of good breeding.

14. Proportion—Shelled Corn to Ear.—10 Points: The proportion of grain is determined by weight. The depth of grains,

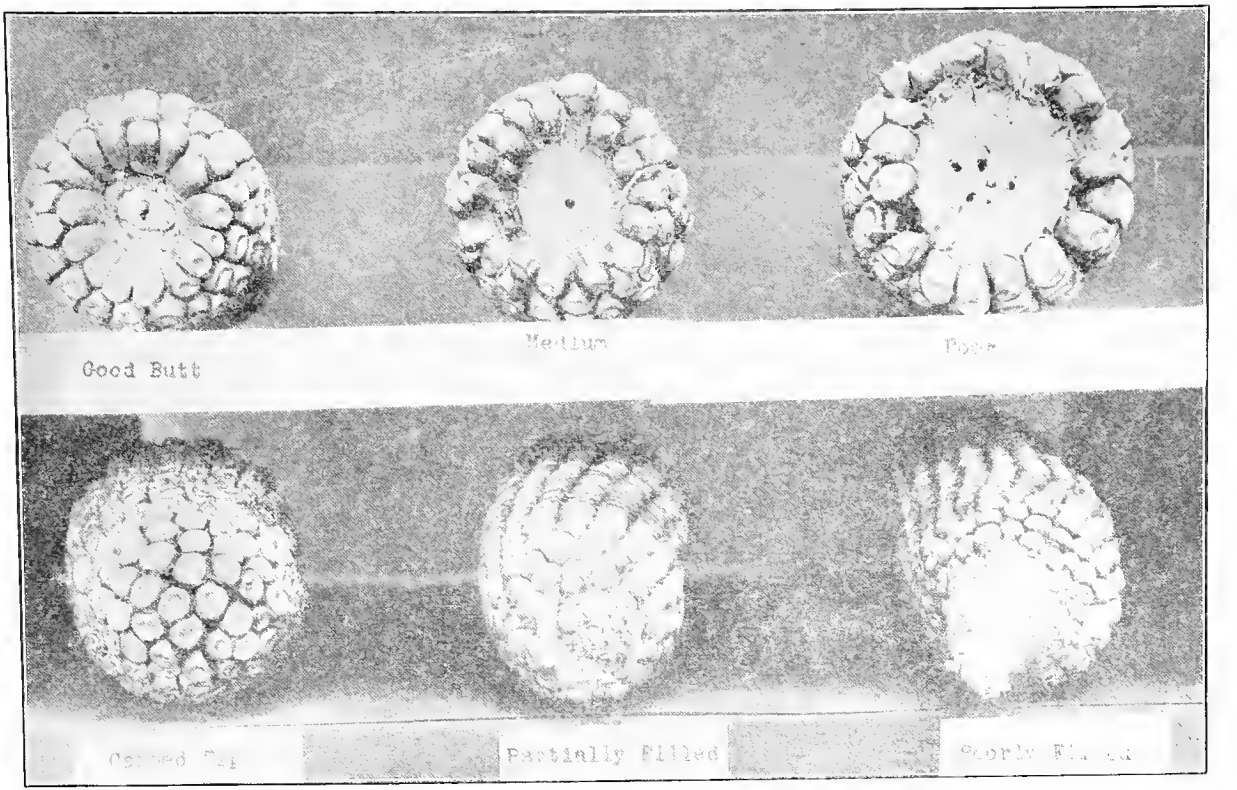
size of cob, the maturity, and space at cob all affect the proportion. In determining the proportion of corn to cob use each alternate ear in the exhibit. Weigh the five ears. Shell off the grain and weigh the cobs. Subtract the weight of the cobs from the weight of the ears and the weight of grain will be determined. Divide the weight of the grain by the total weight of the five ears and the percentage of corn will be determined. For every per cent short of standard for the variety a cut of one per-cent should be made.

Remarks

As has been said before, the score card is intended to be largely suggestive. It is not an infallible guide but is to be used rather as a staff, or cane, as it were, to help us and to give a little more intelligent direction as to the essential points to be observed in selecting corn either for seed or for exhibition purposes.

It should be borne in mind that while these ideal points and characteristics of the score card as described in the foregoing explanatory notes are desirable, other things being equal, the lack of perfection may not prevent a variety from producing high yields or having in other particulars desirable qualities. For example, the cob should be neither too large nor too small. It is evident that of two ears of equal size and compactness, the one with the small cob will have a deeper kernel and will contain more grain. On the other hand, while the small cobs may show a larger proportion of grain, yet the total weight of the ears may be much less and the yield per acre smaller. A good sized cob that is not obtained at the sacrifice of the depth of the kernel will contain the largest amount of grain. Excessively large cobs are objectionable in that they usually carry a larger percent of water, thus lowering the keeping quality of the grain and its vitality for seed.

In a well-proportioned ear, the shelled corn will occupy about the same space as the ear did before it was shelled. It is a good relationship where the depth of grain is one-half the diameter of the cob, or the circumference of the ear twice that of the cob.



Buts of Ears: (1) Well Rounded. (2) Moderately Rounded. (3) Shallow or even.
Tips of Ears: (1) Capped Tip. (2) Partly Filled. (3) Poorly Filled.

OATS SCORE CARD

Report of Committee

At the annual meeting of the Illinois Corn Growers' Association held January 29, 1906, the following resolution was presented and adopted:

Whereas, It is desirable and necessary for members of the Illinois Corn Growers' Association to grow oats in connection with corn growing, be It

Resolved, That the following score card and rules for oats judging be adopted for the ensuing year:

Score Card for Oats

Points	Perfect score	Score of sample
1. Trueness to type	15	
2. Uniformity of kernel in size and shape	10	
3. Purity of color	15	
4. Cleanliness	10	
5. Seed condition	15	
6. Proportion of hull	10	
7. Weight per bushel	25	
Total Points	100	

Explanation of Points

1. Trueness to Type.—Kernel of the same character.

2. Uniformity.—Kernels of similar size and shape.

3. Purity of Color.—All the kernels of the same color, white, yellow or black, according to the variety.

4. Cleanliness.—Freedom from straw, chaff, weed seeds, and trash.

5. Seed Condition.—Clean; all of one grade; large kernels; unbleached; strong vitality and free from dampness, mustiness and sprouting.

6. Proportion of Hull.—Estimate proportion of hull by hulling a few representative kernels.

7. Weight per Bushel.—Determine the weight with a grain tester; should weigh 38 pounds per bushel.

Rules for Judging

1. The proportion of cut for color shall be determined by finding the percentage of mixture in the sample.

2. The amount of hull in American varieties is about 30 per cent. If the proportion is estimated to be greater than this it should be cut accordingly.

3. In scoring weight per bushel, a cut of one point shall be made for every pound short, down to 32 pounds. For every pound short below 32 pounds, a two-point cut shall be made.

4. If a sample is scoured or clipped, it may be cut from 5 to 20 points, at the discretion of the judge.

PART IV.

Studies of the Different Parts of a Kernel of Corn

(Special acknowledgment is made to Dr. C. G. Hopkins, of the Illinois Agricultural Experiment Station, for use of matter in following pages compiled from Bulletins Nos. 43, 55, and 87.)

Composition of Corn

The composition of the different parts of the corn kernel is determined by chemical analysis which shows the different substances which the kernels contain, and also the amount or percent of each substance.

Most food stuffs are separated by analysis into six different elements, or groups of elements, as indicated below.

1. *Water.*—In grain or corn stover which seems very dry there is still a considerable amount of water or moisture, usually not less than 10% or 12%. In ensilage, fresh corn fodder and root crops the amount of water is very much more; usually from 70% to 90%. After the water is removed from a food, all that remains is called *dry matter*, or water-free substances.

2. *Ash.*—By the term ash is meant the mineral matter which remains when the dry matter is burned. That part of the dry matter which passes off in burning is called "organic matter." This organic matter constitutes by far the largest and most valuable part of the corn kernel as food. Organic matter is separated by analysis into four classes, known as protein, fat, fiber and carbohydrate extract.

3. *Protein.*—All the organic matter which contains nitrogen is called protein. The nitrogenous elements are the chief constituents necessary to growth and repair of the animal body. Gluten or wheat flour is one kind of protein.

4. *Fat.*—This consists mainly of the oil or fat which is found in the corn. It is practically pure corn oil. After subtracting the protein and the fat from the organic matter the remainder is called the "carbohydrate."

5. *Fiber.*—The woody structure or frame work of the corn kernel, or of plants, is called fiber. Fiber of flax and that of hemp are familiar examples. Paper is largely made from woody fiber. Fiber constitutes a part of the carbohydrates.

6. *Carbohydrate Extract.*—This substance consists chiefly of starch, but includes also the small amounts of other closely related substances found in corn, such as sugar, gum, etc.

Those parts or substances in a food which the animal digests and uses are called digestible *nutrients*. The analysis of food shows what constituents it contains and the digestible nutrients are determined by digestion experiments. The uses which the animal makes of each substance as a nutrient, is a most important consideration, For instance: if an animal is required to produce nitrogenous products such as milk or eggs or animal growth, it will require more protein than is required by an animal which is at rest and neither growing nor producing such substances. Thus it is necessary to intelligently study the making up of a properly balanced ration for stock feeding. It is therefore well to know the uses which the animal makes of the different constituents that go to make up corn.

An element is a substance which cannot be divided by any known means into two different substances. Iron is an element because pure iron contains nothing but iron and it cannot be separated into anything but iron. Sulphur and carbon are also elements. Some elements exist in the form of gas—such elements as oxygen and nitrogen of which the air is composed chiefly. Water is a compound of two elements, oxygen and hydrogen, both of which are gases. Sugar is a compound of these two elements and the element carbon. If sugar is heated the elements oxygen and hydrogen are driven off mainly in the form of water or steam, and only one element, black carbon, remains.

The cut given on the opposite page represents the chemical composition of an average sample 100 ounces (approximately 4 quarts, or ½ peck or ⅛ bushel) of good sound corn as determined from the analysis of 163 samples. The first bottle on the left represents 100 ounces of corn; the other six bottles show the different substances of which this sample is composed as follows:

Carbohydrates	70.4 ounces
Protein	10.3 "
Oil	5.0 "
Crude Fiber	2.2 "
Ash	1.5 "
Water	10.6 "
	100.0

Ash or mineral matter contributes largely to the formation and repair of the bones of animals. While some food-stuffs contain a sufficient supply of ash to meet the requirements, yet corn as a single ration is deficient in this element as has been proved by experiments.

The first bottle at the left represents 100 ounces of shelled corn. The six bottles at the right represent the chemical composition of this corn as determined by analysis. The elements are as follows: Carbohydrates, 70.04 ounces; protein, 10.3 ounces; oil, 5 ounces; crude fiber, 2.2 ounces; ash 1.5 ounces; water 10.6 ounces.

A recent experiment in swine feeding conducted at the Illinois Agricultural Experiment Station by Prof. William Dietrich, showed that during a six months' feeding period, beginning with pigs three months old, it required about twenty-one pounds of corn to produce one pound of grain in live weight, where nothing but corn was fed. In another pen handled similarly, except that ash was added to the ration in the way of hard wood ashes and charcoal, it only required about nine pounds of corn to produce one pound of grain. This feeding experiment which will soon appear in bulletin form, emphasizes the importance of supplying ash in a corn ration, especially when fed to growing pigs.

Protein is the only nutrient of the food which contains the element nitrogen. Something of the importance of protein in the food may be understood from the fact that lean meat, hide, ligaments, membranes, tendons, internal organs, and, in fact, all the working parts of the body except the bones are composed almost entirely of protein. The albumen or white of eggs is a very pure form of protein. For the highest product of milk or eggs or animal growth, foods rich in protein are necessary.

Fat of the food may be used to supply energy or it may be transformed into animal fat.

Carbohydrates, including digestible fiber and carbohydrate extract (starch, or sugar, etc.) are used mainly to furnish energy, but they are also converted, to a considerable extent, into animal fat. It should be borne in mind that fat and carbohydrates serve the same purpose in animal nutrition, namely, the production of force, heat, and animal fat, while protein serves primarily a very different purpose, namely, the building up and repairing of nearly all the working parts of the animal body.

In calculating the values of foods the water and ash are usually omitted, but the amount of digestible protein is carefully considered and also the total value of digestible food as a source of energy. The power of food to furnish energy when it is consumed in the body is called potential energy or fuel value.

The analysis of corn and other foodstuffs is usually given on the basis of one hundred parts of dry matter in order that they may be comparable since the amount of water is so variable with the changes of weather, etc., that a fair comparison cannot be made except on the basis of water-free substances.

It may be stated that although the water usually constitutes more than half of the animal body, the water which is contained in food is of no more value as a nutrient than the same amount of water that the animal takes in its daily drink. The percent of

water in both the grain and stover of corn when field cured is extremely variable. When corn is husked and thoroughly dried out in the crib, the grain will contain, under ordinary conditions, from ten to twelve percent of water; but at the time of husking contains much more. For example, the Illinois Agricultural Experiment Station found, from an investigation covering a period of three years, the average percent of water in varieties of different maturities to be as follows:

	Number of varieties tested	Average percent of water
Early maturing varieties	44	17.1
Medium maturing varieties	103	21.3
Late maturing varieties	45	26.4

On this basis one thousand bushels of medium maturing corn would lose, upon becoming thoroughly air-dry, a weight of water equal to one hundred and fifteen bushels of shelled corn. If this one thousand bushels of shelled corn could be sold for fifty cents a bushel at husking time, it would be necessary to get fifty-seven cents a bushel when thoroughly air-dry in order to receive the same amount of money for it. The weight of corn at husking time does not, therefore, indicate accurately its food value.

The following is an abstract from Bulletin No. 87, "The Structure of the Corn Kernel," by Dr. C. G. Hopkins.

Parts of the Corn Kernel

"There are six distinctly different parts in a kernel of corn, as will be readily seen by reference to Plate 1, page 25.

1. Tip Cap.—This is a small cap covering the tip end of the kernel and serves as a protection to the end of the germ. It consists of material somewhat resembling the cob and occasionally in shelling corn the tip cap remains attached to the cob, leaving the tip end of the germ uncovered, but nearly always it remains on the kernel.

2. Hull.—This is the very thin outer covering of the kernel. It consists largely of carbohydrates, especially fiber or cellulose, although it also contains a small percentage of other constituents.

3. Horny Glutenous Part.—This part lies immediately underneath the hull. It constitutes a second covering of the kernel, usually much thicker than the hull. For short it is called *horny gluten*, although it is, of course, not pure gluten. However, it is the richest in protein of any part of the corn kernel.

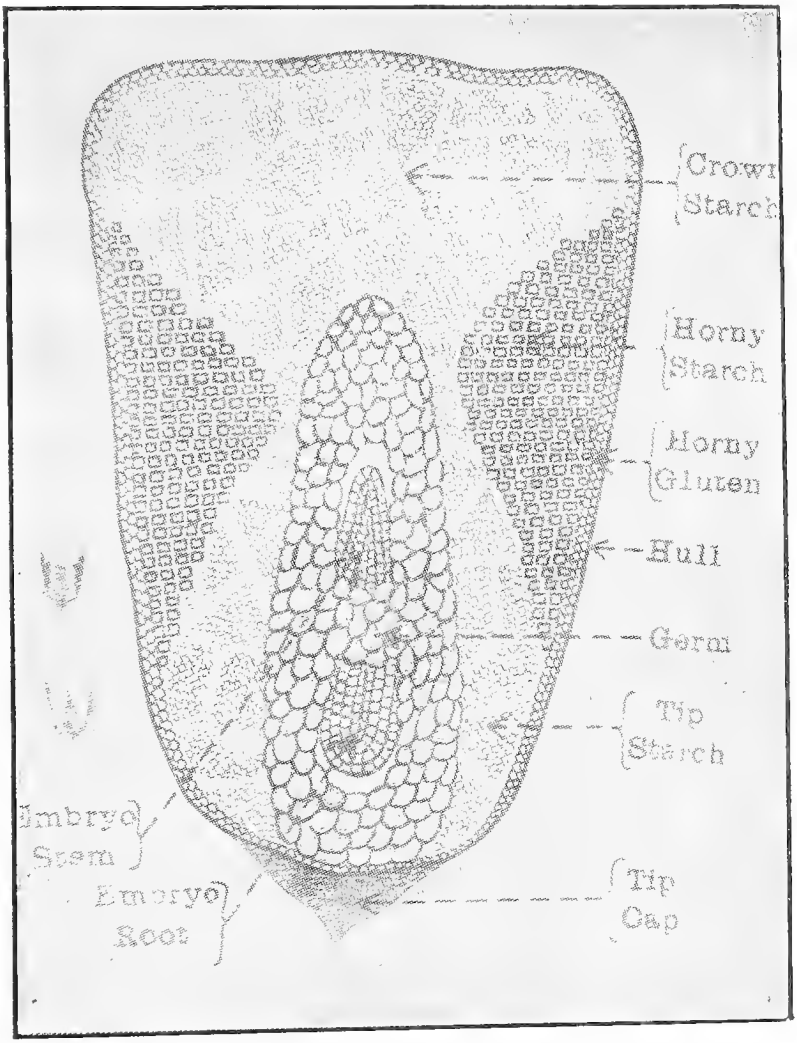


PLATE 4.—LOW PROTEIN CORN KERNEL FROM DRAWING; SMALL KERNELS FROM PHOTOGRAPHS.

4. Horny Starchy Part.—This part lies next to the horny gluten, on the back and sides of the kernel. For short it is called *horny starch*, although it is not pure starch, as it contains considerable amounts of other constituents, especially of protein. In an examination of the kernel with the unaided eye the horny glutenous part and the horny starchy part are not readily distinguished from each other, the line between them being somewhat indefinite and indistinct. Considered both together these two parts constitute the horny part of the kernel.

5. White Starchy Part.—This part occupies the crown end of the kernel above the germ and it also nearly surrounds the germ toward the tip of the kernel. For convenience this material is called white starch, although it is not pure starch. In some kernels the horny starch extends nearly or quite to the germ (near the middle of the kernel) and thus separates more or less completely the white starch into two parts, which we call *crown starch* and *tip starch*.

6. Germ.—The germ occupies the center of the front of the kernel toward the tip end and usually extends about one-half or two-thirds of the length of the kernel. Within the body of the germ are the embryo stem pointing upward toward the crown end and the embryo root pointing downward toward the tip end of the kernel, both of which are, of course, parts of the germ. These embryo parts within the germ may be easily seen by anyone who will carefully shave off the front side of the germ from a kernel of corn." (See small photographic reproduction of sections of kernels in Plate 1.)

Mechanical Separation of the Different Parts

It is not a difficult matter to obtain very pure samples of each of the above-named parts of the corn kernel, although in making the separations there is of necessity some waste material consisting of a mixture of three different parts: namely, horny gluten, horny starch, and white starch.

By the use of a small sharp knife any one can make the following separations:

1. Tip cap.
2. Hull.
3. Horny gluten.
4. Horny starch.
5*a*. Crown starch.
5*b*. Tip starch.
6. Germ.
7. Waste (mixed material).

In making these separations the kernals are first soaked in hot water for fifteen or twenty minutes.

The tip cap is then very easily and perfectly separated by simply cutting under one edge and then pulling it off.

The hull is separated without difficulty by peeling it off in strips. It is only necessary to use the knife to start the peeling at the tip end where the hull has been broken by removing the tip cap. With some care the hull can be completely peeled out of the dent in the corn.

The horny gluten is more easily distinguished after the hull is removed. It will be plainly seen that it covers the entire kernal excepting possibly the exposed part of the germ. The horny gluten is removed by carefully shaving it off with a sharp knife. Adhering particles of starch can be more easily separated from the horny gluten after the shavings have been allowed to dry for some time. In scraping off these particles of horny starch or white starch adhering to the shaving more or less horny gluten will also be scraped off, so that, while we are thus able to obtain a pure clean sample of horny gluten, we also obtain some waste material, consisting of particles of horny gluten, horny starch, and white starch.

The germ is next removed, and with care this can be done very perfectly. If any particles of starch adhere to the germ they can easily be completely removed. After the tip cap, hull, horny gluten, and germ have been removed, the remainder of the kernel, consisting of horny starch and white starch only, is allowed to dry, and the kernel is broken in two lengthwise.

The crown starch is dug out with the knife as completely as possible without taking any of the horny starch.

The tip starch is next removed in the same manner as the crown starch.

The horny starch from each side usually remains in a solid piece. This is now carefully scraped to remove all adhering particles of white starch or horny gluten, the scrapings being carefully saved and added to the waste material.

By this method of separation we obtain eight different products, including the waste material, and seven of these products are pure samples of distinctly different parts of the corn kernel, excepting crown starch and tip starch, both of which, of course, belong to the white starch; they are kept separate, however, because they are found in different places, frequently being entirely separated in the kernel, although more commonly there is some white starch continuous from crown to tip.

A bushel of ordinary shelled corn, weighing 56 pounds, contains about 4½ pounds of germ, 36 pound of dry starch, 7 pounds of gluten (rich in protein), and 5 pounds of bran or hull (mostly fiber), the balance in weight being made up of water, soluble matter, etc. The value of the germ lies in the fact that it contains over 40 percent of corn oil, worth, say 5 cents per pound while the starch is worth 1½ cents, the gluten 1 cent, and the hull about ½ cent per pound.

PART V.

Commercial Products of Corn

(Special acknowledgment is made to Mr. Roy B. Simpson, formerly of the Glucose Sugar Refining Company, Chicago, for use of matter compiled from a recent address.)

Until recently corn has been considered only as of value for the making of cornbread and cakes, beef, pork and whiskey. However, when man comes to study this marvelous plant in a scientific way, science evolves other products in rapid succession. From it now come the finest qualities of oils for table purposes, for the mixing of paints, for lubricating purposes, for manufacturing soap, etc. It yields gum, sugar and syrup which cannot be surpassed. From it is obtained vulcanized corn oil or corn rubber which is used in the manufactur of rubber goods and linoleums; and from the stalk is made the finest grades of paper. The pith of the stalks is converted into cellulose which is used to protect warships from shot and shell.

The economic possibilities of the corn crop are only beginning to be understood. In order that you may understand something of the methods employed, we will attempt to briefly describe what may be seen on a short trip through one of the big factories which turn out by-products of corn. The Glucose Sugar Refining Company of Chicago is one of the largest cash buyers of corn in the world. When all their factories are running at full capacity their daily purchases amount to one hundred and eighty thousand bushels, and they employ nearly fifteen thousand people.

The chemical composition of the corn-kernel is of great importance, not alone to the farmers and stockmen, but to the glucose factories. The glucose companies buy only shelled corn and when it reaches the various factories it is passed through a cleaning machine which removes all dust, dirt, and pieces of cob so that when the corn is ready for the steeping tanks every kernel is bright and shiny as though polished by hand. It is then immersed in these tanks which are called steeps, each of which has a capacity of about one thousand bushels of grain and eight thousand gallons of water. This disintegrating process called steeping is carried on from thirty to forty hours. When sufficiently softened the water is drawn off into a special receptacle and reserved for future use. The softened corn is then passed into the steel mills where are discs which run vertically in opposite directions and at very high speed. This process re-

moves the hull, frees the germ and breaks up the starch body. Water being used on these mills there is now a heavy, sticky mass instead of the kernels. This mass is then passed into a large trough of running water, the germ, being rich in oil and consequently lighter in weight than the remainder of the mass, rises to the surface and is carried off into special tanks. The remainder of the mass which has sunk to the bottom of the trough then passes through burstone mills of the same type as those used for flour. The object of this second grinding is to get the gluten, bran and starch in as finely ground condition as possible. From these mills where it has again received an addition of water and is now become very thin it is passed over frames covered with very fine silk bolting cloth called shakers. This bolting cloth retains the bran and allows the starch and gluten to pass through. The separation of starch from the gluten is the most difficult task of all. It is accomplished by the use of long, slightly inclined planes known as starch tables. The starch being heavier than the gluten sinks to the bottom when the fluid of the starch-milk, as it is called, which has been previously collected is run off the tables. The starch by thus settling to the bottom is built up in layers and the gluten is carried off of the end of the tables and drained into large settling tanks. Upon these tables is thus left a solid mass of starch containing about fifty percent of water. In order to remove the water from the starch thus broken up it is placed in special kilns which thoroughly dry it. It is then in marketable form.

Starch is the basis of a large number of commodities including glucose, grape sugar, dextrine, and several varieties of gum. It is also used for various purposes by paper mills, laundries, confectioners, and in baking powder and culinary purposes.

Glucose is one of the important products having starch as its base. Glucose is simply corn syrup and should be known by its correct name. It is a heavy, transparent syrup, two-thirds as sweet as cane syrup. In solid form it is known as grape sugar. There are a number of uses for the manufacture of glucose. It is used by confectioners in the manufacture of the finest candies. It is also used by bakers and manufacturers of syrups. It is said that the Glucose Sugar Refining Company puts out more than four thousand barrels of glucose per day. Corn syrup in its purity is without flavor and a very small quantity of cane syrup is added to give color and flavor. The most popular brand of syrup on the market contains ninety percent corn syrup and ten percent cane or sugar syrup.

Leaving the glucose department we will return to the germ or heart of the corn. These germs are thoroughly dried and ground to a very fine powder or meal. This meal is then cooked and placed in a hydraulic press, the oil being extracted at a very high pressure. The residue comes from the press in the form of a very hard cake one inch in thickness, just as the pomace comes from the cider press. This residue is known commercially as corn oil cake, and when ground, germ oil meal. Enormous quantities of this cake are exported to foreign countries for the feeding of live stock, and it is also largely in demand for the same purpose in this country.

Corn oil is the most valuable product of this kind manufactured although the quantity made is small when compared with that of starch. This oil is used by paint manufacturers, soap makers, and in the manufacture of rubber substitute. Vulcanized corn oil, or corn rubber, as it is called, is made by submitting oil to a vulcanizing process which solidifies it and gives it the same appearance and identically the same odor as pure rubber, but it does not have the elasticity or durability of the pure para rubber, which costs more than six times as much as corn rubber. Corn rubber is used in the manufacture of rubber boots and shoes, belts, door mats, linoleums, ets.

There is a part of the corn kernel which is adapted only to feeding of live stock; this is the bran and the gluten. The bran which was left upon the silken frames, or shakers, is thoroughly washed by sprinklers to free it from starch. It is then removed to large revolving drums which are heated by steam, after which it is thoroughly dried and is then ready for market. Gluten feed is a mixture of bran and gluten and is one of the standard concentrated stock feeds, just as is cotton-seed meal or linseed meal.

This is a brief extract of what has been told of the commercial side of the corn plant. Corn is the most useful of the cereals and as we become better acquainted with it both from the viewpoint of the producer and the manufacturer we can see greater and more glorious possibilities for it in the years to come.

PART VI.

Suggestions for Corn Experiments

On the following pages is outlined a series of experiments arranged to be carried on during the summer and autumn which are designed to bring out certain facts relative to the growth and maturing of the corn. It is important that the work should be done at the proper time, and as nearly as possible according to the directions in order that the results may be comparable.

During the course of these experiments and observations many other interesting facts will come under the eye of the experimenter. While this may mean some trouble, yet we are sure that you will be fully repaid by forming a closer companionship with the corn plant.

Careful attention to every detail in the growing and harvesting of a plot of corn will be suggestive and will enable you to discover much for yourself. A careful study of some particular plant such as corn by scientific methods applied with practical discretion and common sense will awaken a new interest in definite and useful work looking to the solving of some of the perplexing problems met by every farmer. Each farm is a local problem and each farmer must be more or less of an experimenter.

EXPERIMENT No. 1

The following is suggested as a record blank for outlining a brief history of some plot or field on your farm, noting the fertility of the soil and the method of preparing the seed bed, etc. The keeping of this record will be of value to the boy who makes it, and if the plot of corn should be raised to compete for a premium offered by an Institute, the data will be in shape for preparing a report at the end of the season.

1. Area of field_____

2. Character of soil, as clay, sand, loam, etc._____

3. What crops were grown on the field in
   - 1903_____
   - 1904_____
   - 1905_____
   - 1906_____
   - 1907_____

4. What amounts and kind of manure were used on this field———

———

5. When was field plowed———

6. Depth of plowing———

7. How was plowed ground prepared for corn———

(a) Number of times and dates disced———

(b) Number of times and dates harrowed———

(c) Number of times and dates dragged or rolled, etc———

8. Date of planting———

(a) Variety of corn———

9. Distance apart of rows———

10. Distance apart of hills in row———

11. Number of stalks in hill———

12. Kind of cultivator used———

13. Depth of cultivation———

14. Time of cultivation { 1st———
2nd———
3rd———
4th———

Additional cultivation———

EXPERIMENT No. 2

Corn—Rate of Growth

Select ten average hills of corn in the field, and drive down a stake eighteen inches long, 2 inches by 2 inches, with flat top close to every hill so as not to interfere in cultivation. The top of the stake should be within two inches of the top of the ground. Secure a pole 10 feet long. This pole can be made by sawing a strip an inch wide off of an inch plank 10 feet long. Mark the pole off in foot, inch and half-inch and quarter-inch spaces so that measurements can be made to the quarter-inch.

Date of Measurement.	Hill 1.	Hill 2.	Hill 3.	Hill 4.	Hill 5.	Hill 6.	Hill 7.	Hill 8.	Hill 9.	Hill 10.

To take the record, set the measuring pole on top of the stake by the side of the hill of corn, pull up the leaves alongside the pole and note the height of the tallest leaf, and record this height in the following outline. Take the record on Saturday of every week until the growth stops.

NOTE.—Number the stakes driven down by the hills so that there can be no possibility of mistake in taking the record of each hill.

EXPERIMENT No. 3

CORN—PERCENT OF SUCKERS

A sucker is a branch from a corn plant. It is usually smaller than the main stalk, has no ear and is altogether an inferior plant. The connection between the stalk and the sucker is usually found at the surface of the soil. Sometimes it will be necessary to dig some of the dirt away from the base of the hill in order to see this connection. In order to find the percent of suckers in the field count all the stalks in 100 average hills of corn in at least three places in the field. Now count the number of suckers in these hills. By dividing the number of suckers by the total number of stalks the percent of suckers will be obtained.

Name of variety of corn.....

Color of ears.....

Kind of cultivation { Shallow..... Deep.....

Name of cultivator.....

Kind of soil { Sand..... Clay..... Loam.....

	No. of stalks.	No. of suckers.	Percent of suckers.
1st 100 hills....	.....	.....	.....
2nd 100 hills....	.....	.....	.....
3rd 100 hills....	.....	.....	.....

Additional Notes:

.....

NOTE.—Give any peculiarity of season, soil, seed, cultivation or other possible reason to account for presence of suckers.

EXPERIMENT No. 4

Corn—Time of Earing and Tasseling

This experiment is intended to find the time that the tassels and ears appear on the stalk, whether the ears or the tassels come out first, and the length of the time between earing and tasseling.

Select ten average hills of corn in a convenient field, and mark with a number so that there will be no difficulty in taking the observations in regular order. Record the time when the young ears, or shoots, and the tassels appear on the stalk in the following outline.

		Hill 1.	Hill 2.	Hill 3.	Hill 4.	Hill 5.	Hill 6.	Hill 7.	Hill 8.	Hill 9.	Hill 10.
Date when tassel first appeared	Stalk 1...										
	Stalk 2...										
	Stalk 3...										

		Hill 1.	Hill 2.	Hill 3.	Hill 4.	Hill 5.	Hill 6.	Hill 7.	Hill 8.	Hill 9.	Hill 10.
Date when first ear appeared	Stalk 1...										
	Stalk 2...										
	Stalk 3...										

Additional notes:

EXPERIMENT No. 5

Corn—Root Pruning

The effect of deep cultivation and injury to the roots of the corn plant can be found by a simple and practical experiment. Pick out nine average rows in a convenient field. It would be a good plan if they could be located near the outside of the field, for convenience in work of pruning, and ease in the observation of results.

For a pruner use a flat spade. Sharpen carefully so that the spade will easily cut off the roots. Measure 4 inches from the edge and mark this distance with a distinct line across the spade. Next, measure 6 inches from the edge of the spade and mark with a line across the spade. Take two 1-inch by 1-inch pieces, 4 inches longer than the spade is wide so that the ends will project 2 inches on each side of the spade. Bolt these strips on either side of the spade so that they can be moved up or down and bolted fast. These strips will form a guard by which the depth of the spade entering the soil can be regulated.

The plan of the experiment is to prune the roots of one row and compare the effect of this method of treatment with the ordinary cultivation. The rows should be cultivated shallow and given as nearly the same cultivation as possible. In this experiment the rows will be pruned two depths, 4 and 6 inches according to the following plan.

Twenty-five Hills Long

Row 1——————Not pruned, ordinary cultivation.
Row 2——————Pruned 4 inches deep, ordinary cultivation.
Row 3——————Not pruned, ordinary cultivotian.
Row 4——————Pruned 6 inches deep, ordinary cultivation.
Row 5——————Not pruned, ordinary cultivation.
Row 6——————Pruned 4 inches deep, ordinary cultivation.
Row 7——————Not pruned, ordinary cultivation.
Row 8——————Pruned 6 inches deep, ordinary cultivation.
Row 9——————Not pruned, ordinary cultivation.

The pruning should be done twice, first, about two weeks before the time of the last cultivation, and second, just after the last cultivation. When ready to prune, set the guard at the mark on the spade corresponding to the depth of the corn to be pruned. Set the spade about 6 inches from the hill and press down so as to cut off all the roots in a straight line, to the depth set for pruning. Set the spade at the four sides of every hill and prune the roots all around the hill to the desired depth. In taking out

the spade be careful not to disturb the soil any more than is absolutely necessary, in order that the difference in results will be due to injury to the roots, and not to the disturbance of the soil. Record any effect of the pruning so far as noticeable in the growth of the plants. In the fall, husk each row separately and carefully weigh the corn, recording the weight in the following outline:

	Number of Ears	Pounds	
Row 1			Not pruned.
Row 2			Pruned 4 inches deep.
Row 3			Not pruned.
Row 4			Pruned 6 inches deep.
Row 5			Not pruned.
Row 6			Pruned 4 inches deep.
Row 7			Not pruned.
Row 8			Pruned 6 inches deep.
Row 9			Not pruned.

Note.—If for any reason you are unable to carry this experiment so far as husking, take notice as to the apparent effect of the root pruning.

EXPERIMENT No. 6

Habit of Growth of Plant Roots

The root system of a plant is doubtless the part that is most important to the plant itself. For instance, all other parts of a corn plant—the leaves, grain, stalk, are dependent upon the roots for life and growth. We should therefore give our very best attention to the roots of plants; but judging by the careless methods practiced by many farmers in preparing and fitting the soil for corn and other crops, and the poor way they care for the soil during the growth of the plants, they evidently think least of and give least attention to the roots of the plants.

To study the habit of growth of the roots of corn, select a well-developed hill of corn, dig a trench six or seven feet long, about three feet wide, and five or six feet deep, letting one side of the ditch come about four or five inches from the base of the hill. This hole should be dug *across* the row rather than lengthwise. Then with a sprinkling can pour water about the base of the hill and wash the soil away from the roots. Carefully loosening the soil with a sharpened stick will hasten this work. In this way the roots can be exposed along the side of the hole, taking care to loosen them as little as possible from their natural position, thus they may be traced laterally and deep as possible. In this connection note the cut on page 40, which represents a corn plant just beginning to tassel.

It is well not to confine this study of the root system of plants to corn alone, but to practice the same method and expose the roots of other plants of different kinds to a depth of three or four feet.

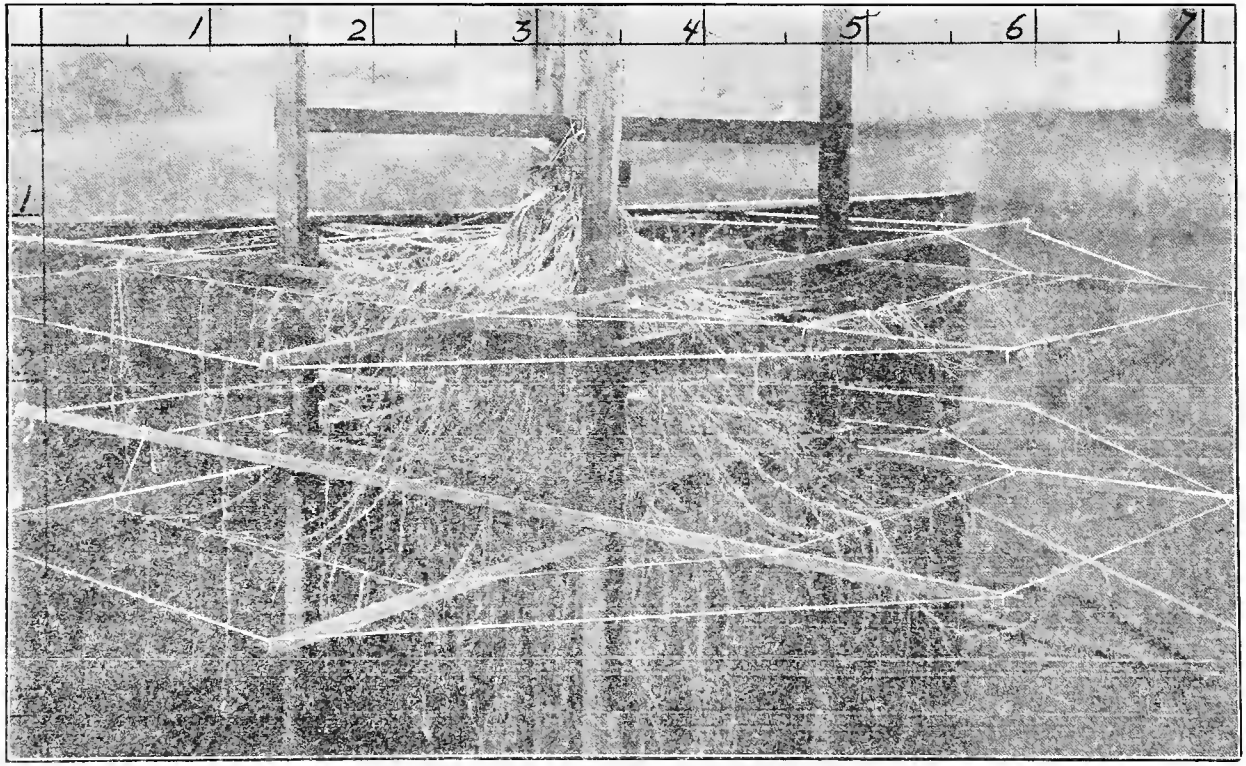
It will be found exceedingly interesting and instructive to trace the roots of cowpeas, soy beans or clover plants. Also the roots of beets, parsnips, sweet potatoes and similar plants penetrate the soil to a greater depth than you perhaps realize. We may thus find out more concerning the habit of growth of roots and understand how the roots do their work for the plant.

From such observations we learn the important lessons of deep and thorough preparation of the soil for a seed-bed, which tends to bring about the soil conditions which are most favorable to the growth and development of the roots of plants. Then we realize the importance of careful, shallow after-cultivation of the crop and thus injure as few of these main side or lateral roots as possible, thereby checking the feeding power of the plant and consequently retarding its growth.

IN CONCLUSION

Those conditions which are necessary for root growth and development of plants are the foundation truths or principles upon which all profitable agriculture is based. It is for each farmer to study these conditions and find how to bring them about in the soil on his own farm. This brings us then to a study of soils which will be taken up in a later circular.

Upon the front of the Agricultural building of the University of Illinois is this inscription from the pen of Dr. Draper: "The wealth of Illinois is in her soil, and her strength lies in its intelligent development." This sentiment lies at the very foundation in building a permanent and profitable agriculture for Illinois, the whole significance of which it is the business of the Agricultural College and Experiment Station to assiduously propagate among the people.



THE ROOT DEVELOPMENT OF A CORN PLANT JUST BEGINNING TO TASSEL.